FO OUTLOOK
NASA AMES RESEARCH CENTER

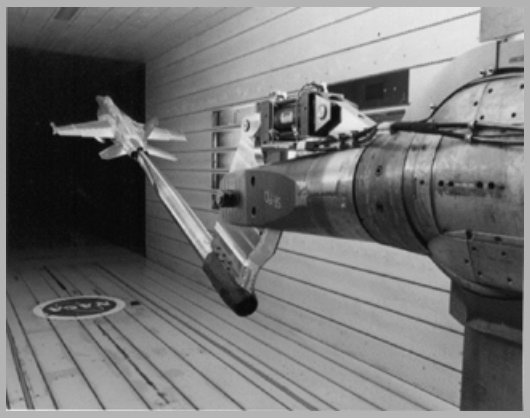
Information for the NASA Ames Aeronautical Test & Simulation Community

August 2001

Serving the Aerospace Industry and Research Community
Wind Tunnel Operations Division
NASA Ames Research Center

"KICK STING" A SUCCESS ON F/A-18E/F TEST

by Chris Natividad



New kick sting mount installed in the 11-Foot TWT for the F/A 18E/F S&C test

Thanks to a team effort by various NASA Ames support groups, the first use of the "kick sting" mount in the 11-Foot Transonic Wind Tunnel was a resounding success. It took only two months to go from hardware design to initial use on the stability-and-control tests for the Boeing F/A-18E/F Super Hornet. This was due to the efforts of Jim Kennon, Hal Reimer, the Ames Machine Shop, John Wallace and Ed Newman.

Previously, in order to conduct tests at both high and low angle-of-attack ranges, personnel had to change the sting model support hardware – an extensive task. The hydraulically actuated kick sting has a built-in fixed 5-degree offset bend and provides a nominal 25-degree kick or sweep, allowing for test operations over an angle-of-attack range of 55 degrees.

During the F/A-18E/F test, the kick sting could be safely operated throughout the test envelope under full aerodynamic load. The kick sting's ease of operation and kick-on-the-fly ability were major factors in the early completion of the Super Hornet test.

The kick sting's versatility was further demonstrated during the AIM-9X Missile test. A 7.5-degee offset roll mechanism was installed on the blade section of the kick sting, which allowed us to study missile aerodynamics at angles of attack up to 48 degees and a full 360 degrees of missile roll angle.

Editor's note: George Rupp contributed to this article.

ENERGY OUTLOOK BRIGHTER FOR WIND TUNNELS

by Catalina Ortiz

This year promised to be gloomy for NASA Ames managers concerned about power for the wind tunnels. In January, California was in the darkest days of its energy crisis, enduring blackouts and soaring prices.

What a difference a few months make. While the availability and price price of energy remain serious long-term concerns, supplies have become plentiful, and wholesale prices have fallen. PG&E, contrary to expectations, has continued a pricing plan that enables Ames to significantly curb costs. These developments helped ease concerns that an ongoing power crisis would put Ames at a disadvantage in the wind-tunnel test market.

"We should now be able to retain competitive power costs for the wind tunnels in relation to our competitors – Arnold Engineering Development Center and Langley," says Tom Aiken, deputy chief of the Wind Tunnels Operations Branch, who oversees the division's power use.

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SPACE TRANSPORTATION BUSINESS PROSPECTS

by Pete Zell

Editor's Note: Pete is working in the FO Division office to identify and attract customers for the NASA Ames wind tunnels.

The world has benefited from over six generations of commercial aircraft development that have reduced air-travel costs to an economical $1 per pound with an extremely low level of risk. In comparison, the Space Shuttle, our first generation of space transportation vehicle, has a low-Earth-orbit cost of $10,000 per pound with a risk level that can be improved. To reduce costs, lower risks and improve the nation's space transportation capabilities, NASA, together with space-launch industry and academic partners, has developed the Integrated Space Transportation Plan. This plan is aimed at restoring U.S. dominance of the space launch industry and providing NASA with the means to continue the scientific exploration of our universe.

The Integrated Space Transportation Plan is a multibillion dollar, five-year effort that has three primary focus areas. One is to upgrade the Shuttle to keep it flying safely and efficiently until about 2012. The second area is called the Space Launch Initiative. This initiative seeks to develop a second generation of reusable launch vehicles (RLVs) to replace the Shuttle. It also explores new technologies to improve the safety, reliability and affordability of future systems. The third focus invests in advanced technologies to develop a third generation of RLVs for the 2025 timeframe. There is strong support in Congress for full funding of the Integrated Space Transportation plan.

Space Transportation Day held at NASA Marshall Space Flight Center in October 2000 provided us with an overview of the status of the nation's space transportation research and development efforts. The meeting coincided with the release of a $900 million NASA Research Announcement (NRA) focused primarily on the Space Launch Initiative. It was very interesting to see the "big picture" of how NASA works to leverage advancements in space. Most of the money is passed to industry to fund their high-risk research and development costs. The desired end result is to have at least two industry competitors fund the final development of a commercially viable RLV. Commercially, viability is expected with a launch cost of about $1,000 per pound and a crew/vehicle risk of one hull loss in 10,000 missions.

Many of the proposals submitted in response to the NRA sought to leverage off of the unmanned, NASA-sponsored, X-plane efforts that were underway: X-33, X-34, X-37 and X-38. Here are quick descriptions and photos of each vehicle.

Lockheed Martin Skunk Works has been developing the X-33, a subscale technology demonstrator of a single-stage-to-orbit RLV. It would launch vertically, like a conventional rocket, reach an altitude of 320,000 feet at Mach 13+, and glide back to a horizontal landing. The X-33 is 69 feet long with a 77-foot wingspan. The full-scale RLV proposed by Lockheed Martin (Venture Star) would be a commercial launch platform with quick turnaround between flights and a low cost per pound transported into Earth orbit.

Orbital Sciences Corp. has been developing the X-34 to test technologies to lower space launch costs. The vehicle would be air launched from a carrier aircraft and achieve speeds of Mach 8 and an altitude of 250,000 feet. The X-34 would carry a variety of experiments to evaluate structural, propulsion, flight control, and thermal-protection concepts. It is 58 feet long with a wingspan of 28 feet.

NASA canceled funding for the X-33 and X-34 in March. The Air Force, however, is now considering whether to fund them.

Boeing is developing the X-37 (Future X Pathfinder) to test technologies in the orbital and reentry environments. The X-37 will be carried to low-Earth orbit on the Space Shuttle or an expendable launch vehicle. The vehicle has an experiment bay, similar to the Shuttle's, and is designed for "aircraft-like" space operations. The X-37 is 27.5 feet long with a wingspan of about 15 feet.

NASA is developing the X-38, a low-cost prototype emergency crew return vehicle (CRV) for the International Space Station. The X-38 makes efficient use of existing equipment and technologies to evaluate atmospheric operations. Following release from a B-52 carrier aircraft, it uses a proven lifting body shape for high-speed flight and slowdown for landing. An Army-developed parafoil is then deployed for final descent to landing. The CRV must be capable of safely returning a crew of up to seven people. It is expected to be about

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ENERGY OUTLOOK BRIGHTER FOR WIND TUNNELS

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Determining the division's electricity needs is complicated by the way wind tunnels use power: They run sporadically but use great amounts of electricity. At any instant, the Unitary Plan Wind Tunnel can draw up to 176 megawatts, enough for a town of 500,000 people. In comparison, all of Ames' buildings put together, excepting the wind tunnels, use 20-25 megawatts.

Ames buys 85-90 percent of its energy from the Western Area Power Administration (WAPA), a division of the U.S. Department of Energy that sells hydroelectric power in 15 Western states. Any power the center draws over 80 megawatts comes from PG&E. WAPA charges the same amount for energy regardless of time of day; however, PG&E uses "real-time" pricing, charging higher rates during the peak hours of noon to 8 p.m.

Since September 2000, when the power crisis became apparent, the division has kept down costs by scheduling tests – which tend to draw on PG&E power – during off-peak hours.

"It's put a burden on the running crews. They're all on off shifts now. We wish it wasn't necessary, but it's something that will be the case for the next year at least," Aiken says.

Earlier this year, the division feared it would loose real-time pricing when PG&E discussed switching Ames to a one-price system. The utility, however, has not taken any steps toward making such a change.

"We should now be able to retain competitive power costs for the wind tunnels in relation to our competitors – Arnold Engineering Development Center and Langley."

Another cause for anxiety was a new contract between PG&E and WAPA, which gets more than half of its power from PG&E. Managers feared the terms of the contract could mean a doubling or tripling of WAPA prices.

But wholesale energy prices have dropped sharply in recent months. New plants and facilities put back online after repairs have increased supply; conservation and cooler-than-expected summer temperatures have reduced demand. Although WAPA's prices will rise when its revised contract with PG&E takes effect at the end of the year, Aiken doesn't think the increase will be dramatic.

ONLINE ENERGY RESOURCES

California Energy Commission
www.energy.ca.gov

California Independent System Operator
www.caiso.com

Western Area Power Administration
www.wapa.gov

Pacific Gas & Electric
www.pge.com

Ames Energy Conservation
code.arc.nasa.gov/jf/energy

Ames wind tunnels' energy costs have risen over the past year – from an average of $55 a megawatt hour to $65-$70 a megawatt hour. But that's less than managers feared. Conservation, Aiken believes, is the primary reason Ames' energy costs haven't risen further.

In June, the center, not counting the wind tunnels, used 15 percent less electricity than it did a year ago. That compares with the state average of 12 percent. Meanwhile, the wind tunnels are getting a break from WAPA; if they greatly reduce electrical demand from 1 p.m. to 8 p.m., Ames will get a rebate of about $1 million.

While the short-term outlook is brighter, ensuring that the wind tunnels have adequate power at affordable prices promises to be a continuing challenge. For instance, if Ames loses its exemption from rolling blackouts, the wind-tunnel division will have to come up with a way to shut down operations in an orderly manner.

"The range of instability has certainly appeared to decrease, but in both the short term and long term, I would expect some more changes," Aiken says.

FO OUTLOOK

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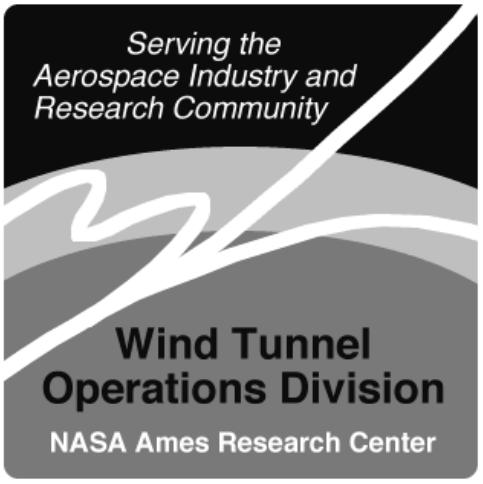
NEW LOGO FOR WIND TUNNELS



logo

\'lo-(,)go, 'lag-\ n. pl **logo-os** \-(,)goz, - (,)oz\ (1937)
1: LOGOTYPE **2**: an identifying statement : MOTTO

The Wind Tunnel Operations Division at Ames Research Center is a customer service organization focused on meeting the testing requirements of the aerospace industry and research community. We recently redesigned our logo to emphasize our focus, clearly stating it across the top. The lower band of color represents the terrestrial surface. It is where we reside and it is where the air and ground vehicles we test originate.

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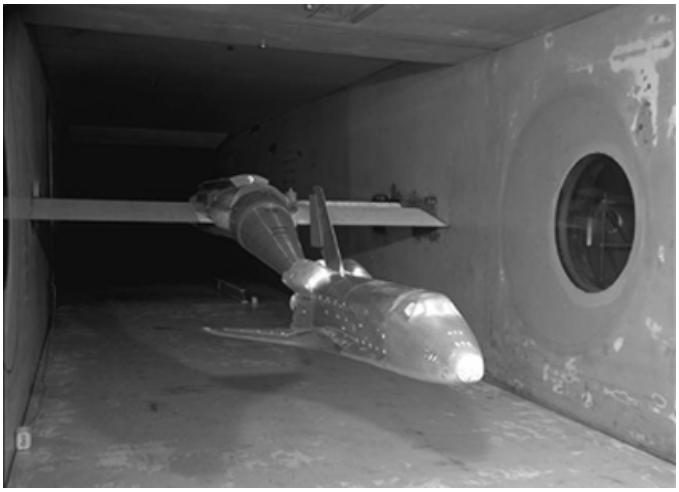
NEW LOGO FOR WIND TUNNELS

(continued from page 4)



Serving the Aerospace Industry and Research Community

Wind Tunnel Operations Division

NASA Ames Research Center

The center band of color represents the Earth's atmosphere. The dark upper band represents space. The three white lines represent contrails or flight paths for global aviation, access to space, and highly maneuverable aircraft. Note that the portion of while line in the lower left corner of the logo runs along the surface and covers the occasional truck, boat, or windmill we test.

– Logo and presentation by Pete Zell

SPACE TRANSPORTATION BUSINESS PROSPECTS

(continued from page 2)

NASA X-38 Crew Return Vehicle

30 feet long with a wingspan of 14.5 feet and could be launched on a booster such as the Ariane 5.

So how does NASA Ames and our wind tunnels fit in to this space transportation effort? Ames plays a significant role in the development of integrated vehicle-health-management (IVHM) systems and thermal-protection systems (TPS). IVHM seeks to deliver and assess vehicle-health data before, during and after flight in an effort to improve overall RPV system efficiency and safety. TPS systems protect the vehicle from the heat of re-entry. Our wind tunnels also have an opportunity to support testing of the current X-plane configurations, TPS samples developed at Ames, and future airframe concepts defined through the NRA.

The 12-Foot Pressure Wind Tunnel and 11-Foot Transonic Wind Tunnel have recently been used to test the X-37. Several years ago we tested the parafoils currently being used for the X-38 in the 80-by-120-foot test section of the National Full-Scale Aerodynamic Complex (NFAC). Future prospects for X-plane wind-tunnel testing include the X-38 in the 11-Foot and the X-37 in the 40-by-80-foot test section of NFAC or the 12-Foot. TPS testing in the 11-Foot using the "bathtub" test bed has been selected for inclusion in the Space Launch Initiative NRA.

The top three technical challenges facing affordable and reliable access to space are arguably to provide reliable engines, robust cryogenic fuel tanks, and durable thermal protection systems. Relatively low on the list is optimizing vehicle low-speed (less than Mach 3) aerodynamics. Despite this situation, the vehicles must have adequate performance and controllability to land safely. We intend to participate with industry and the other NASA centers to provide high-quality wind tunnel services in support of this goal.

FO's primary objectives for attending the Space Transportation events at Marshall were to become aware of our potential role in this long-term program, to advertise our services to potential customers, and to make industry and NASA contacts. We made progress on all of these objectives and are now planning specific actions to help potential customers realize the benefits of large-scale (greater than 6 percent) wind tunnel testing in our facilities.

Boeing X-37 "Future Pathfinder"

NFAC PIGEON EXCLUSION AND REMEDIATION

by Gayle Frank

Six months ago, doorways and exterior stairwells at the National Full-Scale Aerodynamic Complex were grimy with pigeon droppings. Today, there's dramatically less waste, thanks to an extensive cleanup and exclusion program.

In recent years, employees have voiced concerns about large accumulations of pigeon droppings at the NFAC. Management placed a high priority on having cleanup and exclusion work done quickly in order to address employee concerns, reduce the potential risk for exposure and improve the environment aesthetically. However, work was delayed because of the time required to research methodologies, gather contract proposals, obtain funding and coordinate with test schedules.

The NFAC pigeon exclusion and cleanup work began in January. Exclusion materials such as netting, metal mesh, and bird wire were installed in the courtyard, south warehouse, and high-bay door. Bird entry points in the attic and south warehouse were sealed with foam and copper wool. The final phase, cleaning and installing exclusion materials in the north courtyard, will be completed in August.

At the Unitary Plan Wind Tunnel, pigeon droppings and feathers clogged water filters and spray nozzles of the cooling system, causing postponement of integrated systems testing for the 9-by-7 Supersonic Wind Tunnel. Cleanup of debris and installation of chicken wire and netting in the area occurred in July.

Remember that pigeons are a hindrance to work at the wind tunnels. Don't feed or otherwise encourage them and keep all exterior doors and windows closed. A continuous cleanup and exclusion program will be necessary to ensure proper functioning of equipment, reduce potential exposure risk to employees and maintain clean surroundings.

PEER AWARDS 2000

2000 TECHNICAL ACHIEVEMENT AWARD

MIKE OSPRING

Mike's contribution to the Division encompasses nearly all of our facilities. He is the person we call for guidance when we encounter technical problems or when we need creative solutions to complex problems, such as the those relating to the Unitary main drive motors. Mike is always willing to take on a challenge. He has mastered highly specialized jobs, like alignment of the 10-bearing Unitary drive line, tuning of the main drive speed control, rebuilding of a 96-MVA transformer and troubleshooting and tuning of the 11-Foot model support. Mike's technical prowess is rivaled only by his ability to motivate and lead others!

2000 SUPPORT ACHIEVEMENT AWARD

ADAM JACKSON

Adam is an integral part of daily wind-tunnel operations in the 11-Foot Transonic Wind Tunnel. He is a source of outstanding support to both the test team and the customer. For the customer, he provides training on Standard Data System and assists with data-requirements development. For the crew, he provides guidance and excellent troubleshooting skills. Adam's interaction skills facilitate the efficient and accurate transfer of our product, quality wind- tunnel data. His enthusiasm for wind-tunnel testing is never exhausted, but on the contrary, grows daily. He is a constant source of motivation for the crew and as such plays a critical role in the Wind Tunnel Operations Division.

PEER AWARDS 2000

2000 QUALITY ACHIEVEMENT AWARD

TOM BRIDGE

Over the past year, Tom has added two major improvements to the Standard Data System which have played a significant role in improving data quality and productivity. The first improvement, Conditional Sampling, is an algorithm that makes it possible to accumulate and store only that raw data which satisfies customer-defined criteria, such as a Mach-number tolerance. This effort has greatly increased data quality. The second improvement was designed as an effort to increase productivity during the FO Division's HATOL test. Two customized data-acquisition schemes were developed, allowing more data points per time interval to be acquired than was previously possible. These enhancements were critical to the success of the HATOL test.

2000 OPERATIONS ACHIEVEMENT AWARD

JIM JOYCE

Jim's knowledge of the Sting/Model Support System for the Unitary Plan Wind Tunnel has proved invaluable over the past three years. As a resource to engineers in troubleshooting controls problems and improving the overall model support system operation, his role is critical. Jim's expertise was demonstrated during the model-oscillation problems encountered on the Boeing 777 test, in which he had the unenviable job of disassembling and reassembling the hydraulics each time one of the motors or servo-valves failed. In addition, his involvement in the redesign of the A-B limit switches was instrumental in producing a functional and maintainable safety system. Jim's understanding of the 11-Foot model support system will undoubtedly prove invaluable at the 9-by-7.